Boundary element methods for acoustic simulations in the time domain

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Abstract

This talk discusses recent progress for the time-dependent simulation of sound emission and sound scattering using boundary element methods. We particularly consider methods adapted to complex and singular geometries or short impulses. Stable numerical formulations of the relevant equations are discussed, and they are exploited to compute the sound reflection depending on the absorption and impedance. We discuss the performance of our methods in applications such as tire noise.

Keywords: Time domain boundary elements, Transient sound, Room acoustics

REFERENCES

[1] Banz, L.; Gimperlein, H.; Nezhi, Z.; Stephan, E. P. Time domain BEM for sound radiation of tires. Computational Mechanics 58 (2016), 45-57

[2] Gimperlein, H.; Maischak, M.; Stephan, E. P. Adaptive time-domain boundary element methods and engineering applications. Journal of Integral Equations and Applications 29 (2017), 75-105.

[3] Gimperlein, H.; Meyer, F.; Özdemir, C.; Stark, D.; Stephan, E. P. Boundary elements with mesh refinements for the wave equation. Numerische Mathematik 139 (2018), 867-912.

[4] Gimperlein, H.; Nezhi, Z.; Stephan, E. P. A priori error estimates for a time-dependent boundary element method for the acoustic wave equation in a half-space. Mathematical Methods in the Applied Sciences 40 (2017), 448-462.

[5] Gimperlein, H.; Özdemir, C.; Stephan, E. P. Time domain boundary element methods for the Neumann problem: Error estimates and acoustic problems. Journal of Computational Mathematics 36 (2018), 70-89.

[6] Gimperlein, H.; Özdemir, C.; Stark, D.; Stephan, E. P. A residual a posteriori estimate for the time-domain boundary element method. Preprint, 2018.

[7] Gimperlein, H.; Özdemir, C.; Stark, D.; Stephan, E. P. hp-version time domain boundary elements for the wave equation on quasiuniform meshes. Preprint, 2018.

[8] Gimperlein, H.; Stark, D. On a preconditioner for time domain boundary element methods. Engineering Analysis with Boundary Elements 96 (2018), 109-114.